

# Green Tea and Oral Health

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## Abstract

The Green tea is obtained from the tea plant *Camellia sinensis* (L.), Common names: Green tea extract, Chinese tea which belongs to the family Theaceae. Tea is the most consumed drink in the world after water. Green tea is a 'non-fermented' tea, and contains more Catechins, than black tea or oolong tea. Catechins are *in vitro* and *in vivo* strong anti-oxidants. In addition, its content of certain minerals and vitamins increases the antioxidant potential of this type of tea. It is a widely used medicinal plant by the trials throughout India, China and popular in various indigenous system of medicine like Ayurveda, Unani and Homoeopathy Green tea has been consumed throughout the ages in India, China, Japan, and Thailand. Recent human studies suggest that green tea contributes to overall oral health. Green tea has been used in dentistry and has a promising role in future. This paper is an attempt to review potential role of green tea in promoting oral health.

**KEYWORDS:** Green tea, *Camellia sinensis*, Catechins, Oral health.

## Introduction

Tea, a product made up from leaf and bud of the plant *Camellia sinensis*, is the second most consumed beverage in the world, well ahead of coffee, beer, and wine and carbonated soft drinks. Originating from India and China, tea has gained the world's taste in the past 2000 years. The economic and social interest of tea is clear and its consumption is part of many people's daily routine, as an everyday drink and as a therapeutic aid in many illnesses.(1) There are three main varieties of tea-green, black, and Oolong. The difference between the teas is in their Processing. Green tea is made from unfermented leaves and reportedly contains the highest concentration of powerful antioxidants called *green tea polyphenols (GTP)*. The term "antioxidant" refers to any molecule capable of scavenging or deactivating free radicals—damaging compounds in the body that alter cells, tamper with DNA (genetic material) and even cause cell death.(1)

Free radicals occur naturally in the body, but environmental toxins (including ultraviolet rays from the sun, radiation, cigarette smoke, and air pollution) also give rise to these damaging particles. Scientists believe that free radicals contribute to the aging process as well as the development of a number of oral health problems including oral cancer. (2)

Antioxidants such as green tea polyphenols in green tea can neutralize free radicals and may reduce or even help prevent some of the damage they cause. Although health benefits have been attributed to green tea consumption since the beginning of its history, scientific investigations on this beverage and its constituents have been underway for less than three decades.(2)

Green tea polyphenols (GTP) may play a role in the risk and pathogenesis of several oral diseases, especially periodontal disease and oral cancer, and related pathologies. (1)

In addition, several studies suggest a beneficial impact of green tea intake on alveolar bone density and dental caries. The aim of this article is to revise the most recent studies on green tea's beneficial effects on oral health and to evaluate its potential interest.

### Plant Description & Composition

Green, tea derived from the leaves of the *Camellia sinensis* plant. Originally cultivated in East Asia, this plant grows as large as a shrub or tree. Today, *Camellia sinensis* grows throughout Asia and parts of the Middle East and Africa. People in Asian countries more commonly consume green and oolong tea while black tea is most popular in the United States. Green tea is prepared from unfermented leaves.(2)

Green tea chemical composition is complex: proteins (15–20% dry weight) whose enzymes constitute an important fraction; aminoacids (1–4% dry weight) such as teanine or 5-*N*-ethylglutamine, glutamic acid, tryptophan, glycine, serine, aspartic acid, tyrosine, valine, leucine, threonine, arginine, lysine; carbohydrates (5–7% dry weight) such as cellulose, pectin's, glucose, fructose, sucrose; lipids as linoleic and linolenic acids; sterols as stigma sterol; vitamins (B, C, E); xanthic bases such as caffeine, theophylline, and pigments as chlorophyll and carotenoids; volatile compounds as aldehydes, alcohols, esters, lactones, hydrocarbons, etc.; minerals and trace elements (5% dry weight) such as Ca, Mg, Cr, Mn, Fe, Cu, Zn, Mo, Se, Na, P, Co, Sr, Ni, K, F and Al.(3)

Due to the great importance of the mineral presence in tea, the healthful properties of green tea are largely attributed to polyphenols, plant metabolites characterized by presence several phenol groups (i.e. aromatic rings with hydroxyls), which derive from L-phenylalanine.(4) The most important GTP's are tannins and flavonoids. The main flavonoids present in green tea include **Catechins**. The 4 major catechins are Epigallocatechin-3-gallate (EGCG) that represent approximately 59% of total catechins; epigallocatechin (EGC) (19% approximately); epicatechin-3-gallate (ECG) (13.6% approximately) and epicatechin (EC) (6.4% approximately). EGCG is the most studied polyphenol component in green tea and the most active. Green tea also contains alkaloids including caffeine, bromine and theophylline.(3) These alkaloids provide Green's stimulant effects. The relative content of green tea Catechins depends on how the leaves are processed before fermentation.(3) Wu and Wei (1) indicated that a cup of green tea (2.5gms of green tea leaves/200ml of water) may contain 90mg of EGCG which is mainly

responsible for its anti-oxidant, anti-carcinogenic, anti-inflammatory and anti-microbial properties.

### POLYPHENOLS AND ORAL HEALTH

Green tea has been considered a medicine and a healthful beverage since ancient times. The traditional Chinese medicine has recommended this plant for headaches, body aches and pains, digestion, depression, detoxification, as an energizer and, in general, to prolong life. (4)

Two defensive functions have been attributed to the effect of GTP's on dental diseases, namely the defences against pathogenic microorganisms and plant predators. (5)

#### Polyphenols in the oral cavity

Direct antioxidant activity of polyphenols is valid in explaining their preventive effect against diseases of the oral cavity where they come in direct contact with tissues before being absorbed and metabolised.(4)

#### Polyphenols and oral cancer

The potential preventive activity of polyphenols against oral squamous cell carcinoma, the most common form of oral cancer is mainly because of Catechins. They inhibit the production of important metalloproteases,(6) thus potentially reducing invasion and migration, inducing apoptosis and growth arrest in both oral cancer and oral leukoplakia cell lines.(7)

#### Polyphenols and periodontal disease

Inflammatory stimulation by periodontal pathogens increases the production of crevicular fluid and induces the chemotaxis of polymorphonuclear leukocytes, which, in order to inactivate periodontal pathogens, release singlet oxygen and hypochlorous acid into the crevicular fluid. The consequent oxidative stress is countered by the antioxidant activity of ascorbate, albumin and urate present in the crevicular fluid and derived from plasma. However, this local oxidative stress may be increased by external factors or systemic conditions, such as smoking, diabetes, obesity and metabolic syndrome. When there is disequilibrium between oxidative stress and antioxidant activity, periodontal tissue destruction may appear. These observations suggest that antioxidant rich diets might inhibit periodontal disease development and progression, particularly in subjects exposed to environmental and dietary sources of oxidative stress.(4,8) Several studies also report that decreased antioxidant activities of crevicular fluid and saliva are associated with the development of periodontitis.(9,10)

GTPs may contribute to increase the antioxidant activity of oral fluids. Delivery of GTPs by holding green tea in the mouth for 2–5 min increases the antioxidant capacity of saliva, and daily consumption of two cups of green tea for 2 weeks increases the phagocytic capacity of the polymorphonuclear leucocytes in the gingival crevicular fluid.(11)

Green tea catechins, used in a slow-release local delivery strip system applied in the periodontal pockets, decrease the pocket depth and the proportion of Gram negative anaerobic rods, while the same catechins show an in vitro bactericidal effect against *Porphyromonas gingivalis* and *Prevotella* sp. Several GTPs inhibit the proteolytic activity of *Porphyromonas gingivalis*. In addition, GTPs counteract the production of prostaglandin E2 induced by *Porphyromonas gingivalis*.(11,12)

### Polyphenols and dental caries

Dental caries is a multifactorial infectious disease in which nutrition, microbiological infection, and host response play important roles. Earlier reports in experimental animals and humans suggested that green tea consumption (without added sugar) reduces dental caries.(13) Linke and LeGeros(14) indicated that frequent intake of green tea can significantly decrease caries formation, even in the presence of sugars in the diet. *In vivo* animal studies have shown that specific pathogen-free rats infected with *Streptococcus mutans* and then fed with a cariogenic diet containing GTP have significantly lower caries scores.(15) Supplementing drinking water of rats with 0.1% GTP along with a cariogenic diet also significantly reduced total fissure caries lesions. Recent findings of Okamoto *et al.* (16) suggest that green tea catechins may have the potential to reduce periodontal breakdown resulting from the potent proteinase activity of *Porphyromonas gingivalis*. In addition, green tea decoctions inhibit alpha- amylase in human saliva, reducing maltose release by 70% and effectively lowering the cariogenic potential of starch containing food.(2) Similarly, Zhang and Kashket(17) reported that green tea extracts inhibits human salivary amylase and may reduce the cariogenic potential of starch-containing food such as crackers and cakes because it may reduce the tendency of this kind of food to serve as slow-release sources of fermentable carbohydrate. It is likely that the cariogenic challenge in a cariogenic diet may be reduced by the simultaneous presence of green tea in the diet.

Apart from their polyphenol content green tea, is a natural source of fluoride and an effective vehicle for fluoride delivery to the oral cavity. According to Simpson *et al.*(18) after cleansing the mouth with tea, approximately 34%of the fluoride is retained and shows

a strong binding ability to interact with the oral tissues and their surface integuments. This fluoride content may have a beneficial impact on caries and may carry out a wide range of biological activities including prevention of tooth loss and oral cancer.(1,7) Nonetheless, the data have suggested that GTP extract may be responsible for the noted effects on oral health and it has been also demonstrated that GTP rather than fluoride contribute to anti-cariogenic potential by inhibition of oral bacteria growth such as *Escherichia coli*, *Streptococcus salivarius*, and *Streptococcus mutans*. Several studies have indicated that GTP inhibits growth, acid production, metabolism, and glucosyltransferase enzyme activity of *S. mutans* and dental plaque bacteria. Thus, green tea has been considered as functional food for oral health and is widely used in toothpaste formulation.(1,18)

### Polyphenols and root canal flora

Horiba N and Maekawa Y (19) et al studied the antibacterial and bactericidal effects of green tea as an intracanal medicament on different bacterial strains and found that extracts of Japanese green tea may be useful as a medicament for treatment of infected root canals.

Prabhakar J, Senthilkumar M et al (20) showed statistically significant antibacterial activity against *E.faecalis* biofilm formed on tooth substrate and demonstrated that it takes 6 minutes to achieve 100% killing of *E. faecalis*.

### CONCLUSION

Green tea has been consumed in China and other Asian countries since ancient times in order to maintain and improve health. Nowadays, green tea is considered one of the most promising dietary agents for the prevention and treatment of many oral diseases and consequently, it is being studied extensively worldwide. Numerous studies in a variety of experimental animal models have demonstrated that aqueous extract of the major GTP designed as Catechins (EGCG, EGC, ECG and EC) possess antioxidant, antimutagenic, antidiabetic, anti-inflammatory, antibacterial and antiviral, and above all, cancer-preventive properties.(1-3) Epidemiological studies suggest that consumption of green tea may have a protective effect against the development of oral cancer. Preclinical studies of green tea and its polyphenolic components have demonstrated antimutagenic and anticarcinogenic activity, and inhibition of growth of tumor cell lines and animal tumor models, including oral cancer.

In addition, several epidemiological studies with humans have demonstrated that regular green tea consumption has beneficial effects and it shows a significant rate of

protection against the development of dental caries and many periodontal diseases. It also contributes to body weight control and to the rise of bone density as well as being able to stimulate the immune system. Catechin antioxidant power is also strengthened by the presence of other phenolic compounds, vitamin C and minerals such as Cr, Mn, Se, and Zn, although specific data regarding this fact are still scarce.(3)

However, conflicting results between cohort studies conducted in different countries may also arise from confusion in the frequency and timing of intake, and the marked contrasts in the socioeconomic and lifestyle factors associated with tea drinkers. It is also important to consider the type of tea or its preparation (e.g., short time vs. long brewing time and hot tea vs. iced tea) due to the marked impact of these factors on polyphenol content and concentration. It is also important to draw attention on the need of further-in-depth studies on the nature and mechanisms of the active green tea compounds, on the bioavailability of the different Catechins in humans, and appropriate dose levels to act as functional food.(3)

Since green tea beneficial oral health effects are being increasingly proved, it could be advisable to encourage the regular consumption of this widely available, tasty and inexpensive beverage as an interesting alternative to other drinks, which do not only show the beneficial effects, but are also more energetic, do contain caffeine (green tea contains less caffeine than black tea, coffee or cola soft-drinks), are rich in additives and/or CO<sub>2</sub>. While no single food item can be expected to provide a significant effect on oral health, it is important to note that a modest effect between a dietary component and a disease having a major impact on the most prevalent causes of morbidity and mortality, i.e., oral cancer should be given substantial attention. Taking all this into account, it would be advisable to consider the regular consumption of green tea in diet.

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